



FIELD PROCEDURES  
APP GROUNDWATER MONITORING  
FLORENCE COPPER PROJECT, FLORENCE, ARIZONA

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August 2, 2012

## 3. FIELD SAMPLING PROCEDURES

### 3.1 Field Logs

For each sampling event, a field log will be generated which includes such information as the date of sampling, depths-to-water, times associated with purging and sample collection, and the names of the sampling personnel. In addition, general activities, unusual events like an extra sample or extra analytical, and any issues or problems (e.g. pump or meter malfunction or possible impact to a well, such as damage to the casing) should be logged. Field data sheets specific to each well are shown in Appendix A. Field sheets are designed for either low-flow or electric pumps. Depth-to-water measurements are recorded on a separate form. A field logbook is used to record general information.

Written record of any field event must be maintained in indelible ink in the appropriate log or field book. Any errors to entries must be crossed out with a single line through the incorrect entry and a new entry made to the side. The new entry must be initialed and dated by the person making the change.

### 3.2 Depth-to-Water Measurement

Depth-to-water measurements (water levels) are collected from all POC wells quarterly. It is preferable to perform all water levels on one day prior to the beginning of sampling. Depth-to-water measurements must also be taken for each well on the day of sampling prior to purging, regardless of previous measurement. Depth-to-water measurements are also collected following purging to determine the pull-down of the well. Average depth-to-water levels at the site are between 200 and 250 feet below ground surface (bgs). Depth-to-water measurements of wells following a three well volume purge can be 450 feet bgs. Depth-to-water measurements should be recorded on the "Water Levels" form (Appendix A). The procedure for depth-to-water measurements is as follows:

- Rinse the water level meter (sounder) prior to placing in each well by spraying with clean water (tap or deionized).
- Lower the meter down-hole until it sounds. Raise it above the water level and lower slowly until it sounds again. Repeat as necessary to get a consistent reading.
- Depth-to-water is then measured from the top of the polyvinyl chloride (PVC) casing (top of casing or TOC), or top of steel monument (TOM), on the north side or the otherwise indicated measurement point.
- Record the water level to the nearest 0.01 foot.

### 3.3 Groundwater Sampling

Groundwater samples will be collected for analytical purposes from the POC wells where sufficient water is available. Prior to sampling, the well must be purged to ensure the sample collected is representative of formation water and is not collected from stagnant water stored within the well casing. Wells can be purged by a 'traditional' three well-volume purge, or by using a low-flow pump.

Purging and groundwater sampling procedures for each type of pump are defined below.

### 3.3.1 Purging with Low-Flow Bladder Pumps

Low-flow bladder pumps are lightweight pumps designed for micropurging and sampling of wells (also known as low-flow sampling). Micropurging is a groundwater purging/sampling technique where the purge rate is reduced to one half-liter per minute (0.5 L/min or 500 milliliters/minute [ml/min]) or less so that the pumping rate does not exceed the formation production rate for a well. Water is pulled horizontally from the formation and not from well casing storage (the stagnant water within the well casing). The benefit of this technique is that purge volumes are greatly reduced.

To ensure micropurging is effective, water level drawdown within the well should be minimized and the drawdown level should remain relatively consistent throughout the purging and sampling process.

The procedures for purging and water sample collection using the low-flow pumps and the micropurge method are as follows:

- Record all information on the Field Sheet for each well (Appendix A).
- Measure the depth-to-water and leave the sounder in the well to monitor drawdown during purging and sampling.
- Connect the compressed air hose from the wellhead to the pump control box. Also connect the compressed air hose from the pump control box to the compressed gas cylinder.
- The pump control box has two controls. The first is air pressure which is the large knob with associated gauge. This manages the air pressure control feed to the pump. In short, the air pressure delivered to the pump needs to be great enough to lift the water out of the well. The second is the cycle rate (pump refill and discharge equals one cycle) of the pump. The pump control can manage up to six cycles per minute.
- The air pressure control gauge has readings in both feet and pounds per square inch (psi). Using the “feet” scale, set the gauge at a level that is at least 20 feet greater than the depth-to-water recorded for the well (e.g. if depth to water is 60, set the pressure to read at least 80 feet).
- The pump control box has a default cycle rate of 4 cycles per minute and should be shown on the digital readout. Start with this cycle rate. The cycle rate is adjusted using the up and down arrows, and the cycle rate is shown on the screen.
- Pump control guidelines for each well are provided in Table 3–Low Flow Operating Parameters. As possible, adjust the pumping rate using the pump cycle rate until the drawdown is less than 0.3 feet and is stable. The purge rate for each well should be governed by drawdown within that well and not the actual flowrate of water.
- Once an adequate pumping rate and effective drawdown is achieved, do not adjust the pump flowrate throughout the purging/sampling process.
- Periodically, measure and record pump discharge rate (flowrate).
- Purge well until the minimum purge volume for each well listed on the field sheets is reached. This minimum purge volume accounts for the dead volume of the pump and tubing below the water table and ensures that subsequent water quality readings are taken on fresh water from formation.

- Once the minimum purge volume has been reached, begin measuring and recording water quality parameters: temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), and turbidity with the field meters. It is preferable to use a flow-through-cell or similar. Effective conditions for metering include a movement of water past the sensor probe continuously.
- Also measure and record depth-to-water on the same interval as water quality measurements.
- Ideally, readings should be taken on 3-to 5-minute intervals. However, for accurate readings, there must be at least one full exchange of water through the flow-through-cell between readings. The volume of the flow-through-cell is approximately 500 ml. Using the pump discharge rate, determine what the minimum measurement interval should be and use this as a basis for determining interval.
- Purging is complete when the readings have stabilized and do not change by more than the following amounts for three consecutive readings.
  - Temperature – 3%
  - pH – 0.1 unit
  - EC – 3%
  - DO – 10% or less than 0.5 milligrams per liter (mg/L)
  - Turbidity – 5% or less than 5 nephelometric turbidity units (NTU)
- Parameters should be within the historical ranges printed on each well's field sheet. If parameters are significantly outside of the historical ranges, recheck the calibration of the field meters. Do not sample a well if the pH is outside of the Critical Limits printed on the field sheets.
- As indicated, water level drawdown should be less than 0.5 feet. If drawdown is greater than 0.5 feet, lower the pump rate as much as possible.

### 3.3.2 Purging with Dedicated Centrifugal Pumps

There are some POC wells that are equipped with dedicated electric centrifugal pumps, which can purge from 5 to 30 gallons per minute (gpm). These wells are purged for three casing plus borehole volumes.

- Record all information on the Field Sheet for each well (Appendix A).
- Measure the water level prior to purging the well. Calculate the three well volume amount on the field sheet.
- Install discharge hose to the sample tee, connect generator to the control panel, and turn the pump on.
- Refer to notes from the previous sampling event for settings. Calculate purge rate by filling a calibrated 5-gallon bucket. The purge rate in gpm equals 300 divided by the number of seconds to fill the 5-gallon bucket. ( $300/30 \text{ sec} = 10 \text{ gal/min}$ )
- Purge water can be discharged onto the ground surface.
- Purge three times the well volume prior to collecting groundwater parameters.

- Record the temperature, pH, EC, DO, and turbidity during purging. Readings should be taken 3 to 5 minutes apart. Readings can be collected by putting the probes in a cup of water and changing the water every few minutes, or by using a flow-through cell which allows the water to move past the probes continuously.
- Purging is complete when 3 well volumes have been discharged, and when the readings have stabilized and do not change by more than 10 percent between readings (5 percent for DO).

### 3.3.3 Sample Collection

Once purging by either method is complete and field parameter readings have stabilized, samples are collected.

- Collect water samples in the appropriate laboratory supplied containers and preserve as stated. New nitrile gloves must be worn to protect the samples from contamination. Some containers have acid to preserve the samples. Take care not to lose the preservative or get any on the skin or clothing. Be sure not to spill the acid or wash out the bottle prior to sample collection.
- Do not increase the pump flowrate during the sampling process, as this can change conditions within the well.
- Samples for metals are to be field-filtered using a 0.45 micron ( $\mu\text{m}$ ) filter placed on the end of the discharge tubing from the pump. Be aware of filter capsule orientation for proper filtration. Prior to collecting a filtered sample, discharge approximately 50 ml of water through the filter to provide rinsing and to initiate constant flow through the filter.
- The sample bottle set for volatile organic compound (VOC) analysis uses volatile organic analysis vials, or VOAs, preserved with hydrochloric acid. VOAs are to be filled with zero headspace (i.e., no bubbles). When collecting from a well with a stainless-steel pump, lower the flowrate as much as possible. To fill a VOA, fill the vial slowly with water running down the glass into the vial to minimize splashing. Fill the VOA until a meniscus shows above the upper lip of the bottle. Slowly set the cap on the bottle and tighten. Then, invert the bottle and tap on it to see if any bubbles are visible. If bubbles are present, open the cap carefully to prevent spillage, fill the VOA cap with sample water, invert, pouring contents into the bottle, and screw the cap on. Be careful not to lose water already collected in the VOA which has been preserved with acid.
- Complete the sample bottle labels. Pre-printed sample labels can be used which can save field time.
- Place the samples in a cooler with ice immediately after collection.
- Complete a Chain-of-Custody (COC) form for samples sent to the lab. COC forms are supplied by the laboratory.
- Take the samples to the laboratory, ensuring there is enough ice in the cooler to keep the samples at 4 degrees Centigrade.

### **3.4 Sample Identification**

Samples are named with the well ID.

When collecting a field duplicate, samples should be named in a way so that the lab does not know which well the duplicate came from. Field duplicates have historically been named M19.0, M19.1, M19.2, etc. Document the name of the field duplicate on the corresponding Field Sheet (Appendix A) and the field log. Enter a different sample time on the duplicate sample bottles and COC so that the laboratory cannot identify the original sample.

### **3.5 Field Quality Assurance/Control Samples**

#### **3.5.1 Field Duplicate**

The duplicate sample will be collected at the same time as the primary sample and analyzed by the laboratory for the same analytical methods as the primary sample. One field duplicate should be collected for every ten well samples collected.

#### **3.5.2 Trip Blanks**

A trip blank sample will be analyzed for each event when VOCs are analyzed. Trip blanks will be prepared by the laboratory and remain with the samples bottles at all times. Upon return to the laboratory, trip blanks will be analyzed for VOCs using the same procedures and methods that are used for the collected field samples. One trip blank will be placed in each cooler containing the samples to be analyzed for VOCs.